START 9513319.1465

0037509

WHC-SD-EN-TI-283
Revision 0

Data Quality Objective for PUREX Deactivation Flushing

DRAFT

JUL 1994
RECEIVED
EDMC

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

CONTENTS

FIGURE

TABLES

DATA QUALITY OBJECTIVE TO SUPPORT FLUSHING OPERATIONS NECESSARY FOR PUREX DEACTIVATION

1.0 INTRODUCTION

This Data Quality Objective (DQO) defines the sampling and analysis requirements necessary to support the deactivation of the Plutonium-Uranium Extraction (PUREX) facility. Specifically, sampling and analysis requirements are identified for the flushing operations that are a major element of PUREX deactivation.

The PUREX Facility (commonly referred to as PUREX) is located in the 200 East area of the Hanford Site. The PUREX Facility was operated to provide supplemental fuel reprocessing capability at the Hanford Site and to separate uranium and plutonium products from irradiated reactor fuel. The 202-A Building (commonly referred to as PUREX) operated from 1956 to 1972. In 1972, PUREX was placed in a standby mode because it was no longer economical to process fuel from only one operating reactor at the Hanford Site. The PUREX Facility resumed operations in 1983 when a backlog of irradiated fuel from the N-Reactor was accumulated. In 1991, PUREX ceased operations and was placed again in a standby mode.

The U.S. Department of Energy (DOE) notified Westinghouse Hanford Company (WHC) in December 1992 that PUREX would operate no longer and directed WHC to deactivate the facility. A draft plan (*PUREX/U03 Deactivation Project Management Plan*) was submitted to the U.S Department of Energy, Richland Operations Office (DOE-RL) in February 1994 for review and comment. The scope of the project plan is oriented toward technical and regulatory issues surrounding PUREX deactivation. A closure plan to be submitted in 10 years will address the *Resource Conservation and Recovery Act of 1976* (RCRA) closure of the PUREX canyon and storage tunnels. The PUREX Closure Plan will be integrated with the *Comprehensive Environmental Response Compensation and Liability Act of 1980* (CERCLA) remediation of the past-practice units and any potential soil or groundwater contamination, and decontamination and decommissioning (D&D) activities.

Irradiated reactor fuel was processed at PUREX to extract, purify, and concentrate uranium and plutonium produced from reactor fuel. Major process components include decladding and dissolution of the fuel elements, and separation and purification of uranium and plutonium by solvent extraction. Some process systems used recycled nitric acid and organic solvents. Other process systems handled, treated, and disposed of gaseous, liquid, and solid waste.

2.0 DQO STEP 1: STATE THE PROBLEM

This document develops the data requirements for flushing the PUREX vessels during deactivation. These requirements shall meet the RCRA requirements for the treatment, storage, and/or disposal (TSD) systems.

2.1 PROBLEM STATEMENT

This DQO identifies the criteria for ensuring that vessels have been flushed and dangerous waste constituents have been removed from a population of tanks and vessels that are identified as TSD facilities in the PUREX RCRA Part A permit. Removal of the dangerous waste solutions is necessary to ensure that PUREX can be left in a state of minimum surveillance and maintenance until it can be closed.

A simplified illustration of the PUREX process flow sheet and identification of waste tanks and vessels is illustrated in Figure 1. Appendix A contains greater detail on the specific components of the flow sheet. The system components that are addressed by this DQO are: Head End, Solvent Extraction, U-Cell, the Auxiliary Maintenance Unit (AMU), the 211-A tanks, and the 203-A Area P-Tanks.

At this writing, the specific Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) milestone associated with deactivation was being negotiated. When this milestone is identified in December 1994, the DQO will be revised and issued to reflect this and other changes that have occurred since the initial publication of the DQO.

Other DQOs will be developed to deal with sampling and analysis requirements for interim-status designation and safe storage of waste in PUREX. Data requirements generated from these other DQOs will be independent from the current problem addressed.

The DQO Process has been used to identify the sampling and analysis requirements for the flushing activities necessary for PUREX deactivation. A list of participants and their respective organizations is presented in Table 1. Four meetings have been held to determine the sampling and analysis requirements. Meeting dates and the attendance of the stakeholders is also presented in this table.

2.2 ISSUE IDENTIFICATION

There are three issues that have an impact on a solution to the problem. These issues are identified below and outlined in detail in Table 1.

2.2.1 Sufficiency of Process Knowledge

Because of the operational requirements and controls placed on PUREX operations, process knowledge and records associated with the PUREX process, the resultant plutonium and uranium products, waste streams (flows to high-level radioactive waste double-shell tanks), and any additional process constituents are recognized by the DOE and the Washington State Department of Ecology (Ecology) as accurate and reliable.

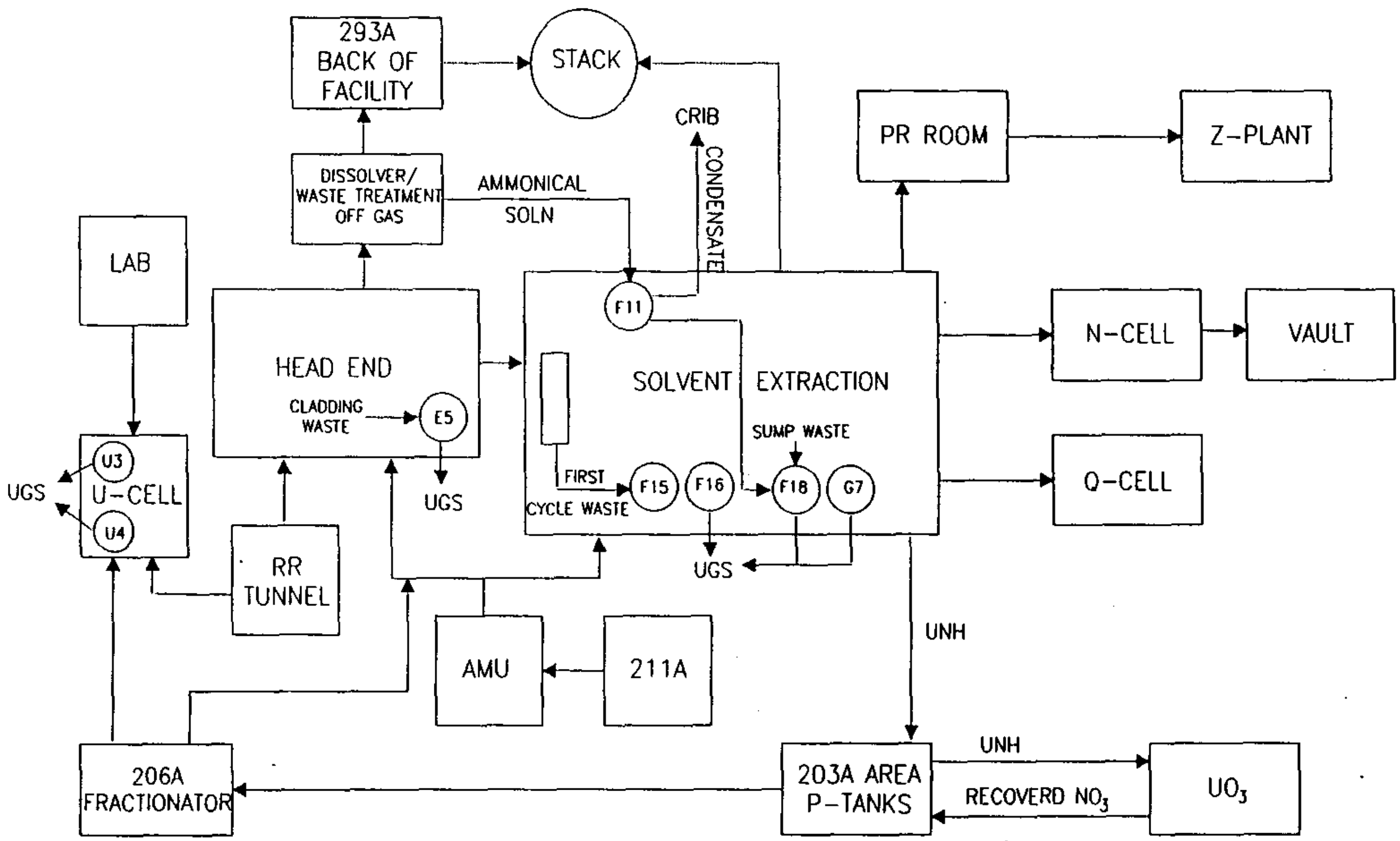

Figure 1. Simplified PUREX Waste Tank and Process Vessel Flow Sheet

2.2.2 Deactivation Time Period and PUREX Ownership

The PUREX facility will transition from EM-60 responsibility to EM-40 responsibility at the completion of PUREX deactivation, which is expected to occur in fiscal year (FY)-99. EM-40 will assume responsibility for all surveillance and maintenance (S&M) activities. It is anticipated that S&M activities will extend through FY-08. Following the completion of S&M, deactivation and decommissioning (D&D) of PUREX will be undertaken. The time duration of D&D is unknown. The final disposition of PUREX will be achieved when integration with CERCLA, D&D, and closure activities have been completed.

2.2.3 Presence of High Radionuclide Activity Levels

The radiaoctive solutions associated with PUREX canyon dangerous waste treatment and storage tank systems will require special personal protection and/or remote handling equipment for all sampling activities. Any information on radionuclide activity levels is provided for information purposes only.

Table 1. PUREX Deactivation Issue Identification

Issue	Assumptions [a]	Constraints [b]	When Data is Required [c]	How Data Will Support Issue Resolution
Sufficiency of process knowledge	Process knowledge and records associated with the PUREX process are considered reliable	Process knowledge addresses all waste associated with the resultant plutonium and uranium products, waste streams (flows to high-level radioactive waste double-shell tanks).	Flushing S&M D&D	Validation of process knowledge
Deactivation time period and PUREX ownership responsibility	The PUREX facility will transition from EM-60 responsibility to EM-40	New and/or additional procedural requirements will occur	S&M D&D	Provide database for historical use
Presence of high radionuclide activity levels (Information only)	Canyon waste treatment and storage tank systems exhibit high activity levels	Personnel protection measures are required for all sampling activities	Flushing S&M D&D	Provide database for historical use

[a] Assumptions used in issue identification.
[b] Physical, technological, and schedule constraints.
[c] S&M: Surveillance and maintenance
D&D: Decontamination and decommissioning

2.3 DQO STEP 2: IDENTIFY THE DECISION

The decisions to be examined in this DQO relate to deactivation flushing criteria that will meet the requirements for RCRA closure of the PUREX TSD units.

The first decision is a process control decision. Flush solutions will be cascaded through each process loop (vessels in series) into the waste transfer tank where samples will be collected. The samples will be taken to the PUREX process control laboratory for analysis. Analyses will be performed with same-day turnaround and the results will be reported to PUREX operations. Sample results will indicate that the process loop is adequately flushed and ready for RCRA sampling, or that the loop is not sufficiently flushed and must be reflushed.

The second decision is a RCRA decision. When a single loop is considered adequately flushed from a process control perspective, RCRA sampling is performed. Samples are collected and taken to the 222-S Analytical Laboratory. Analyses are performed with an initial turnaround of less than 45 days, and the results are reported to PUREX process operations. Final laboratory results are reported to PUREX process operations within 216 days. Sample results either indicate that the loop is adequately flushed and meets RCRA requirements or that the loop is not adequately flushed to meet RCRA requirements. If the loop does not meet RCRA requirements, it must be reflushed and re-evaluated to determine whether RCRA requirements are met.

Two additional questions are addressed for informational purposes only. One question deals with the presence and concentration of other metals in the loops. The second question deals with the activity level within the loop.

Table 2 presents the decisions that must be made and the possible outcomes of the decisions.

Table 2. PUREX Deactivation Decision Identification

Decision or Question	Possible Outcomes or Answers
Are flushing operations complete from a process control perspective?	Single Flush Loop a. Loop is adequately flushed and ready for RCRA sampling b. Loop is not adequately flushed and the loop must be reflushed All Loops a. All loops are adequately flushed and RCRA samples have been performed adequately b. Remaining loops are not flushed and RCRA samples must still be taken from the remaining loops
Are flushing operations complete from a RCRA perspective?	Single Loop a. Samples meeting RCRA criteria are acceptable and loop is deactivated b. Samples meeting RCRA criteria are not acceptable and additional samples must be collected for the loop All Loops a. Samples meeting RCRA criteria are acceptable and all loops are deactivated b. Samples meeting RCRA criteria are not acceptable and additional samples must be collected from the remaining loops
What is the activity level within the loop? (Information only)	Single Loop and All Loops Activity levels of each single loop and all loops are obtained (may be based on process knowledge)

2.4 DQO STEP 3: IDENTIFY THE INPUTS TO THE DECISION

The decision variables that address the decisions and the questions are presented in Table 3. The type of variable is identified. A variable may be an individual observation (i.e., one sample), the average value of several samples, the maximum of several samples, or an upper or lower confidence value of the average of several samples. The basis for the variable is then identified. If the variable is used to support a decision to continue or not to continue flushing, the basis is process control. If the variable is used to support a decision to support RCRA acceptance of the flushing activity, the basis is RCRA compliance. Other parameters required to estimate the value of the decision variable are also provided.

Table 4 summarizes the flushing loops that will be used during the deactivation flushing campaign.

Table 3. PUREX Deactivation Decision Variables Identification

Decision or Question	Primary Decision Variable [units]	Type of Variable [a]	Basis for Variable [b]	Additional Parameters [c]
Are flushing operations complete from a process control perspective? Are flushing operations complete from a RCRA perspective?	ICP Metals Cadmium [ppm] Chromium [ppm] Lead [ppm] Barium [ppm] Silver [ppm]	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes
	Arsenic [ppm]	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes
	Selenium [ppm]	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes
	Mercury [ppm]	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes
	pH	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes
	TOC [wt % dry basis]	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes

Table 3. PUREX Deactivation Decision Variables Identification

Decision or Question	Primary Decision Variable [units]	Type of Variable [a]	Basis for Variable [b]	Additional Parameters [c]
	VOA [ppm]	Single observation	Process Control RCRA	Physical parameters required to compute flow rates and volumes
Are flushing operations complete from a process control perspective?	Nitrates/Nitrites [ppm] (Information only)	Single observation	Process Control	Physical parameters required to compute flow rates and volumes
	Other IC anions [ppm]	Single observation	Process Control	Physical parameters required to compute flow rates and volumes
What is the activity level within the loop?	Radionuclides [nnn] (Information only)	Average activity level	Information only	To be supplied

[a] Represents whether the variable is an individual observation (i.e., one sample), the average value of several samples, the maximum of several samples, or an upper or lower confidence value of the average of several samples.

[b] If the variable is used to support a decision to continue or not to continue flushing, the basis is process control. If the variable is used to support a decision to support RCRA acceptability of the flushing activity, the basis is RCRA compliance.

[c] Other parameters required to estimate value of the decision variable

ICP: Inductively coupled plasma
ppm: Parts per million
RCRA: *Resource Conservation and Recovery Act of 1976*
TOC: Total organic carbon
IC: Ion chromatography

2.5 DQO STEP 4: DEFINE THE STUDY BOUNDARIES

The study boundaries are relevant vessels within the PUREX canyon and support vessels outside the PUREX canyon, and other vessels contained in the Part A permit that have already been deactivated and are available for flushing operations. There are 72 vessels in 13 loops in the PUREX canyon. However, not all of these loops are/will be included in the Part A revisions. There are to be determined (TBD) vessels in TBD loops outside the canyon. There are TBD vessels in TBD process loops contained in the Part A permit that have already been deactivated and are available for flushing operations.

Table 4. Flushing Loops for the PUREX Canyon and Vault System Deactivation

SYSTEM	NO. OF COLUMNS	NO. OF COLUMNS	NO. OF MISC. VESSELS
1 Flush K-Cell Vessels (T-J7, E-J8, TK-K1, T-K2, T-K3, E-K4, TK-K5, TK-K6)	3	3	2 concentrators pH, Cd, Cr
2 Flush L-Cell Vessels (T-J6, T-J4, TK-J5, T-L1, T-L2, TK-L3, T-L4, T-L5)	2	6	0 pH, Cd, Cr
3 Flush Headend Feed Vessels and H1, H2 and F-Cell Vessels (TK-E1, TK-D4, TK-D3, TK-H1, T-H2, TK-F7, E-F6, TK-F26)	6	1	1 concentrator pH, Cd, Cr
4A Flush F and R Cell Vessels (Part A) (T-R1, TK-G1, T-G2, TK-G2, TK-G8)	4	1	0 pH, Cd, TBP
4B Flush G and R Cell Vessels (Part B) (T-R2, TK-R2, TK-R8, TK-R5, D-R6, TK-R7, TK-G5, D-G6)	5	1	2 decanters pH, Cd, Cr, TBP
5 Flush Backcycle Waste and Neptunium Package Vessels (E-H4, TK-J1, TK-J21, T-J22, T-J23, TK-J3)	3	2	1 concentrator pH, Cd, Cr
6 Flush U-Cell Vessels (TK-U8, T-F5, TK-F3, TK-U5, E-U6-2, T-U6, TK-U4)	4	0	2 towers 1 reboiler pH, Cd, Cr
7 Flush Cladding Waste Vessels (Dissolvers A3, B3, C3 and TK-D1, TK-D2, TK-E3, G-E2, G-E4, and TK-E5)	4	0	2 centrifuges 3 dissolvers pH, Cd, Cr
8 Flush M1 Vessel	1	0	0 pH, Cd, Cr

9 Flush J2 Vessel	1	0	0
10 Flush U3 Vessel	1	0	0 pH, Cd, Cr
11 Flush D5, E6, F8, F13, F15, and F16 Vessels	6	0	0 pH, Cd, Cr
12 Flush F11 System Vessels (TK-F10, E-F11, TK-F12, TK-F18)	3	0	1 concentrator pH, Cd, Cr
TOTAL VESSELS (72)	43	14	15 misc. vessels
* 3 dissolvers will be flushed however, passivated zirconium hulls will remain.			

2.6 DQO STEP 5: DEVELOP A DECISION RULE

Table 5 summarizes the sampling and analysis methods that will be used to determine that the PUREX loops have been properly flushed. When it is determined that the individual constituent concentrations are at or below the designation limit, the process loops will be considered to be adequately flushed. If an individual constituent's concentration is above the designation limit, the process loop will be re-flushed until the individual constituent is at or below the designation limit.

Table 5. Sampling and Analysis Methods for Decision Variables

Decision Variable	Sampling Method and Matrix	Analysis Method [a]	MDL/IDL [b]	Analytical Accuracy Required [c]	Analytical Precision Required [d]
ICP Metals	Liquid	LA-505-151		TBS	
Cadmium			0.1 mg/L		± 4 %
Chromium			0.004 mg/L		± 3 %
Lead			0.005 mg/L		± 4 %
Barium			0.01 mg/L		± 3 %
Silver			0.05 mg/L		± 4 %
Arsenic	Liquid	LA-355-131	0.002 mg/L	TBS	± 10 %
Selenium	Liquid	LA-365-131	0.004 mg/L	TBS	± 20 %
Mercury	Liquid	LA-325-102	0.0004 mg/L	TBS	± 10 %
pH	Liquid	LA-212-102	n/a	TBS	± 1 %
TOC	Liquid	LA-344-106 Combustion tube/wet basis	1	TBS	± 3 %
VOA	Liquid	LA-523-405			
Benzene			0.005 mg/L	92 %	± 4 %
Carbon Tetrachloride			0.005 mg/L	76 %	± 4 %
Chlorobenzene			0.005 mg/L	97 %	± 5 %
Chloroform			0.005 mg/L	96 %	± 4 %
1,2-Dichloroethylene			0.005 mg/L	97 %	± 5 %
1,1-Dichloroethylene			0.005 mg/L	78 %	± 7 %
Methyl Ethyl Ketone			0.1 mg/L	90 %	± 4 %
Tetrachloro-ethylene			0.005 mg/L	85 %	± 5 %
Trichloro-ethylene			0.005 mg/L	95 %	± 4 %

Table 5. Sampling and Analysis Methods for Decision Variables

Decision Variable	Sampling Method and Matrix	Analysis Method [a]	MDL/IDL [b]	Analytical Accuracy Required [c]	Analytical Precision Required [d]
Vinyl Chloride			0.01 mg/L	70 %	± 5 %
Nitrates/Nitrites	Liquid	TBS	TBS	± nn %	± nn %
Other IC anions	Liquid	TBS	TBS	± nn %	± nn %
Other metals	Liquid	TBS	TBS	LOE	LOE
Radionuclides	Liquid	TBS	TBS	LOE	LOE

[a] Primary and Confirmatory
[b] Value at which PUREX/UO3 laboratory must report to __
[c] Percent recovery of sample [%]
[d] Relative percent deviation (RPD) [%]
MDL: Maximum detectable limit
ICP: Inductively coupled plasma
TOC: Total organic carbon
VOA: Volatile organic analysis
IC: Ion chromatography
LOE: Level of effort

2.7 DQO STEP 6: SPECIFY ACCEPTABLE LIMITS ON DECISION ERRORS

Table 6 illustrates the acceptable limits on the decision errors.

Table 6. Error Tolerances and Consequences for Decision Variables

Decision Variable	Impact of False Negative [a]	Impact of False Positive [b]	Range of Indifference	Critical Range of Concern (Designation Limit)
ICP Metals	Inadequate information obtained to support S&M and D&D phases Increase exposure to sampling personnel Increase cost of process sampling Extend process sampling schedule	Increase cost of RCRA sampling Extend RCRA sampling schedule Increase exposure to sampling personnel Additional waste generation due to flushing operation		
Cadmium			≤ 1 mg/L	> 1 mg/L
Chromium			≤ 5 mg/L	> 5 mg/L
Lead			≤ 5 mg/L	> 5 mg/L
Barium			≤ 100 mg/L	> 100 mg/L
Silver			≤ 1 mg/L	> 5 mg/L
Arsenic			≤ 5 mg/L	> 5 mg/L
Selenium			≤ 1 mg/L	> 1 mg/L
Mercury			≤ 0.2 mg/L	> 0.2 mg/L
pH			2 ≤ pH ≤ 12.5	< 2 or > 12.5
TOC			≤ 10 wt% (wet basis)	> 10 wt% (wet basis)
VOA				
Benzene			≤ 0.5 mg/L	> 0.5 mg/L
Carbon Tetrachloride			≤ 0.5 mg/L	> 0.5 mg/L
Chlorobenzene			≤ 100 mg/L	> 100 mg/L
Chloroform			≤ 6 mg/L	> 6 mg/L
1,2-Dichloroethylene			≤ 0.5 mg/L	> 0.5 mg/L
1,1-Dichloroethylene			≤ 0.7 mg/L	> 0.7 mg/L
Methyl Ethyl Ketone			≤ 200 mg/L	> 200 mg/L
Tetrachloro-ethylene			≤ 0.7 mg/L	> 0.7 mg/L
Trichloro-ethylene			≤ 0.5 mg/L	> 0.5 mg/L
Vinyl Chloride			≤ 0.2 mg/L	> 0.2 mg/L
Other metals	n/a	n/a	n/a	n/a

Table 6. Error Tolerances and Consequences for Decision Variables

Decision Variable	Impact of False Negative [a]	Impact of False Positive [b]	Range of Indifference	Critical Range of Concern (Designation Limit)
Radionuclides	n/a	n/a	n/a	n/a

[a] False Negative: Do not observe analyte exceeding action level when it exceeds action level
[b] False Positive: Observe analyte exceeding action level when it does not exceed action level
S&M: Surveillance and Maintenance
D&D: Decontamination and Decommissioning
ICP: Inductively coupled plamsa
TOC: Total organic analysis
VOA: Volatile organic analysis
RCRA: *Resource Conservation and Recovery Act of 1976*

2.8 DQO STEP 7: OPTIMIZE THE DESIGN

Table 7. PUREX Deactivation DQO Participants

Name	Organization	4/26/94	4/28/94	5/03/94	5/12/94
Krekel, Randall RCRA Closures Program Manager	DOE-RL	x	x	x	
Krupin, Paul Tri-Party Agreement Integration	DOE-RL			x	
Senat, Gene PUREX Deactivation Program Manager	DOE-RL	x	x	x	
Jaraysi, Moses PUREX Deactivation Program Manager	Ecology	x	x	x	
Russell, Laura Regulatory Support	Ecology	x	x	x	
Stone, Alex Chemist	Ecology	x	x	x	
Uziemblo, Nancy Chemist	Ecology	x	x	x	
Duncan, Dan PUREX Deactivation Program Manager	EPA	x	x		
Bhatia, Ravi Program Engineer	WHC		x		
Griffin, Paul D&D Projects	WHC	x	x	x	
LeBaron, Greg PUREX Deactivation Program Manager	WHC	x	x	x	
Robertson, Julie Regulatory Support	WHC	x	x	x	
Ruck, Fred RCRA Closures Program Manager	WHC			x	
Smith, Ed Regulatory Support	WHC	x	x	x	
Stephenson, Mike Regulatory Support	WHC	x	x	x	

Table 7. PUREX Deactivation DQO Participants

Name	Organization	4/26/94	4/28/94	5/03/94	5/12/94
Strobhen, Bill Analytical Services	WHC			x	
Waite, Jack Tri-Party Agreement Integration	WHC			x	
Weiss, Richard Analytical Services	WHC	x	x		
Winters, Bill Chemist	WHC			x	
Cook, John Program Engineer	MACTEC	x	x	x	
Redus, Kenneth Facilitator	MACTEC	x	x	x	
Sheriff, Jennifer Facilitator	MACTEC	x	x	x	

DOE-RL	U.S. Department of Energy, Richland Operations Office
EPA	U.S. Environmental Protection Agency
Ecology	Washington State Department of Ecology
WHC	Westinghouse Hanford Company
MACTEC	MAC Technical Services Company